

exposure, we shall obtain three positives, each showing but one-third of the original negative, and at the same time representing a different color sensation. An ordinary half-tone plate is now made from each positive, in the usual manner, and then printed successively in yellow, red and blue inks, the same as in the ordinary chromo-typographic or three-color process.

In the case under consideration you will note the almost perfect result, without the presence of the objectionable mathematical cross-line hatch-work.

This latter adaptation of the Joly process, I am informed, is the invention of two young men in this country; and should it prove practical and give certain results, it will without doubt be a great step forward in chromo-typography, and also have commercial value.

It is a curious fact that the foundations of the interesting processes I have described are based, and depend for their ultimate success, upon the ruling machine—an invention of Joseph Saxton, a former member of this Society, specimens of whose early photo-mechanical reproductions, made in 1841, are still in our possession.

In conclusion, I will state that the one great advantage which this process seems to offer over other schemes in heliography or the three-color process, is the fact that but a single negative is required, which is obtained by the ordinary methods of photography, so that all special or intricate apparatus, with uncertain results, are obviated. It will be further noted that the specimens shown here to-night are among the earliest ones made, with crude appliances as to the ruling of the screens and the pigments.

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*Second Contribution to the History of the Cotylosauria.\**

*By E. D. Cope.*

*(Read before the American Philosophical Society, May 15, 1896.)*

The examination of new material derived from the Permian formation of Texas enables me to make some important additions to the knowledge of the Cotylosaurian Reptilia, as set forth in my synopsis published in these PROCEEDINGS for November, 1895 (p. 437).

In the first place, I have to describe a type new to the order, and which resembles nothing hitherto found in the Permian beds of North America, or apparently elsewhere. It must be referred to a new family with the following name and characters.

\* Read before the U. S. National Academy of Sciences April, 1896.

## OTOCÆLIDÆ.

Posterior border of temporal roof excavated laterally by the meatus auditorius externus. Teeth present in a single row, not transversely expanded. Ribs immediately overlaid by parallel transverse dermoössifications which form a carapace.

In the presence of the meatus auditorius this family differs from the other members of the Cotylosauria. In the latter the vestibular space is enclosed by the lateral part of the temporal roof, and has no distal inferior bounding wall. The meatus results in the Otocælidæ not merely from the excavation of this roof but also from the excavation of the posterior border of the suspensorium. In Conocheetes this excavation is not great, but in Otocælus it is very considerable, the proximal extremity of the suspensorium having the anterior position seen in the Loricata and Testudinata. It resembles the quadrate of the latter order in the decurvature of the proximal extremity into a descending hook, which partially bounds the meatus posteriorly.

This meatal excavation constitutes an approximation in the Cotylosauria to other and later orders of Reptilia, where it is nearly universal. It is interesting to observe that it precedes in time the division of the roof into longitudinal bars by perforation, in the series of which the Otocælidæ form a part. This fact renders it probable that it is from this family that the order of the Testudinata has descended. It may also be found that the Pseudosuchia have the same origin. The carapace of the Otocælidæ approaches nearly that of the genus *Typtothorax*\* Cope, of the Trias; where each rib is expanded, and bears above it a distinct dermosseous band of equal width, with a sculptured surface. This genus probably belongs to the Pseudosuchia, whose type genus *Aëtosaurus* Fraas, has a carapace consisting of transverse bands of osseous plates in mutual contact. The transverse segmentation of the carapacial bands of Otocælus would produce such a structure. The same character is found in the genus *Episcoposaurus* Cope of the Trias, where the cranium is unknown. A reduction of the number of the transverse bands of the Otocælidæ would approximate the carapace to that of the Testudinata. The arrangement of the clavicles and episternum is quite like that of the corresponding elements in the anterior lobe of the plastron in the tortoises. The median and posterior part of the abdominal wall of the Otocælidæ is unknown. The teeth are quite insignificant,

\*In the last edition of Dana's *Geology*, 1895, p. 758, it is inaccurately stated that "A large Crocodilian of the genus *Belodon* has been described by Cope . . . under the name of *Typtothorax coccinarum*." The fact is, that two animals were included in the description, which I afterwards determined to belong to different genera. The one for which I reserved the name *Typtothorax* does not belong to the genus *Belodon*. See *Proc. Amer. Philos. Soc.*, 1887, p. 200, Plate I, where the genus and species are defined. Recently Marsh has described (*Amer. Journ. Sci. Arts*, July, 1896, p. 61) the cast of a similar reptile from the Trias of Connecticut, to which he gives the name *Stegomus arcuatus*. He does not distinguish the supposed new genus *Stegomus* from *Typtothorax*.

and their loss would bring us again to the Testudinata type. Their implantation in deep alveoli is reptilian in character.

I have pointed out that the notch in the posterior border of the cranial table in the stegocephalous Batrachia was probably covered by a membrum tympani, since the stapes terminates there. This notch is the first appearance of a meatus auditorius in the Vertebrata, and it is not present in all Stegocephalia. It seems that the members of the Cotylosauria differ among themselves similarly, some presenting the meatus, and others lacking it. In *Conodectes* the character approaches that of the Stegocephalia more nearly than it does in *Otocelus*.

In the *American Naturalist* for 1885, p. 247, I published the conclusion that the Testudinata were descended from the Theromora. In my system at that time the Theromora included the Cotylosauria. In 1892 (*Trans. Amer. Philos. Soc.*, p. 24), I distinguished the Cotylosauria as the primitive source of the Testudinata. The discovery of the Otocelidae renders it almost certain that this anticipation was correct.

In this family the slight posterior concavity of the quadrate region of the Diadectidae is extended forwards to a great distance, and the osseous tympanum is produced further outwards. The position of the parts is different from that which is characteristic of the Stegocephalia, where the tympanic notch, when present, is superior, owing to the much greater length of the suspensorium. The dental characters also distinguish this family from the Diadectidae. No ossicula auditus were found in the tympanic cavity.

Two genera of this family are known, and are characterized as follows:

Mandible articulated much anterior to cranial border; nostrils opening vertically.....	<i>Otocelus</i> Cope.
Mandible articulated posteriorly and on line of posterior border of skull; nostrils opening horizontally.....	<i>Conodectes</i> Cope.

Two species of *Otocelus* and one of *Conodectes* are known from the Permian bed.

#### OTOCÆLUS TESTUDINEUS, *Amer. Naturalist*, 1896, 399.

*Char. gen.*—Teeth with simple subconic crowns. Mandibular ramus not produced posterior to quadrate. Superior cranial bones strongly sculptured.

This genus is established on a skull from which the muzzle anterior to the orbits has been broken off. On its under side, pushed forwards out of place, are a considerable part of the shoulder-girdle, the head of the humerus and a bone of the forearm. On another block, which was found with it, is a part of the carapace, two vertebrae, numerous ribs and both hind legs, lacking the tarsus and digits. The legs and vertebrae were not found attached to the foreleg and the skull, but the actual contact of the corresponding parts is found in the type specimen of another species, the *O. mimeticus*.

There is considerable resemblance between several parts of this animal and those of the stegocephalian Batrachia. This is seen in the forms of the femur and of the shoulder-girdle, which are similar to those which I have referred to Eryops. The close approximation of the huge auricular meatus to the orbit is only seen elsewhere in the anurous Batrachia. The teeth on the other hand are of strictly reptilian type in their mode of implantation, and the lack of dentinal inflections distinguishes them from those of many of the genera of Stegocephalia. There is nothing in the shoulder-girdle to distinguish it from the Cotylosauria, and the humerus so far as preserved is of the type of that order. It is impossible to get at the occipital condyles without destroying important parts of the specimen. The vertebrae are amphicœlous.

It is probable that in life the species of this genus had an enormous tympanic drum.

The tabular part of the skull is large as compared with the facial part. Its posterior border is broken in the *O. testudineus*, but it is continued to a transverse line posterior to the auditory meatus. It was not probably produced into horn-like processes. The suspensorial part of the quadrate is directed posteriorly below. The mandibular ramus has a horizontal expansion of the inner side just anterior to the short angle.

The clavicles have the distal expansion overlapping the episternum characteristic of the order. The shaft makes an obtuse angle with the expanded portion, and is compressed. Its proximal extremity is expanded into a rounded disc, whose plane is horizontal and at right angles to that of the shaft. Between the shaft and the mandibular angle the edge of the pterygoid is visible. The episternum has the posterior part broken off. The part preserved is a transverse plate, which has, like the clavicles, a smooth surface. The scapula lacks the proximal end. Distally it presents a strong longitudinal ridge which extends to the coracoid. Anteriorly the shaft expands into a procoracoid laminar extension in its plane. The coracoid is small and has a convex internal border, which is not notched as in the Pelycosauria. It may be coössified with the scapula. The humerus has a greatly expanded head and a narrow shaft.

The femur is longer than the tibia, and displays the condyles characteristic of the Cotylosauria and Pelycosauria. They are unequally produced posteriorly. There is a long and strong anterior crest.

Two vertebral centra are only moderately well preserved. They are probably anterior dorsals. They are wider than long and are separated by a large and protuberant intercentrum. A free intercentrum of the same shape lies at one side. It is probable that a rather short neural spine rises to the inferior side of the carapace. Only the part next the carapace can be seen in the specimen.

The ribs are much expanded, but do not touch each other. The carapacial bands alternate with them above, resting on their adjacent edges and separated by narrow interspaces. Towards the supposed

anterior part, the superior costal surfaces rise between the carapacial bands to the plane of the latter, forming a closer surface than posteriorly.

This genus forms a remarkable example of homoplastic resemblance to the rhachitomous genus *Dissorhophus*, which I described in the *American Naturalist* for November, 1895. The superficial resemblance is very great, and it is only after an examination of the constitution of the carapace that the difference of this part of the structure in the two genera is observed. In the batrachian genus the ribs are free from and not in contact with the carapace, and the inferior stratum of the latter consists of the expanded neural spines. (See Plate X.)

*Char. specif.*—Muzzle very short and broadly rounded. Top of head between and posterior to orbits flat. Orbits directed principally upwards. Intertympanic width 2.5 times interorbital width. Table of skull posterior to orbits about as long as wide. Postorbital width (longitudinal) half as great as interorbital width, which is equal transverse diameter of orbit. Long diameter of orbit obliquely directed outwards and forwards. Malar bar narrow. Quadratojugal surface posteriorly overhanging border of mandible a little, and these contracted to an apex overhanging angle of mandible posteriorly. Mandibular angle undivided. The superior surfaces of the skull have a strongly impressed honeycomb sculpture, the ridges between the pits being frequently interrupted. The sculpture extends to the inferior border of the mandible. The pits average 2 mm. in diameter. The sculpture is present on the external surface of the posttympanic hook, where the decurved border is concave. The median parts of the frontal and parietal bones are smooth, but whether this is normal or is the result of weathering I do not know.

The mandibular ramus presents, a short distance anterior to the angle, a horizontal expansion with convex border directed inwards and in contact with the pterygoid.

The crowns of the teeth are acute and smooth. They overlap the edge of the lower jaw and are separated by interspaces equal to their own diameter. They are of quite small size.

The articular face of the humerus extends downwards on the inner border of the head; perhaps it is restricted to this part of the latter. The section of the shaft is semicircular.

The fragment which contains the vertebræ, hind leg and carapace, does not form a fit with any fractured face of the mass containing the skull. As, however, everything about the two blocks is harmonious, and as they were found close together, I have no doubt of their pertinence to the same skeleton. The second block is split longitudinally, so that only one-half of the carapace is preserved; but at the supposed proximal end enough of the middle portion remains to include the two vertebræ already described. A portion of one hind leg, including the distal part of the femur with the tibia and fibula, lie over the carapace

externally, while the three principal elements of the other leg lie on the inferior side of the carapace. Both legs are extended in the same direction, *i. e.*, forwards.

The shaft of the femur has a triangular section, the external face concave owing to the prominence of the anterior crest. The external condyle is produced further posteriorly than the internal, and is a continuation of the general distal surface and is not reflected on the posterior face as in so many of the Pelycosauria. The anterior face is flat above and shallowly concave at the condylar border below. The head of the tibia is expanded and the shaft narrowed, as in Pelycosauria. It is straight, while the fibula presents towards it a concave outline; and the two extremities of the latter are about equally expanded.

The surfaces of the vertebral centra are slightly concave anteroposteriorly. The intercentra are somewhat swollen and knob-like on the inferior face. It is probable that the ribs are less closely adherent to the carapacial bars posteriorly than anteriorly. As already remarked, anteriorly the ribs emerge between the bars to form part of the surface; medially the ribs are below the bars but touch them. Further posteriorly a cross section displays a rib which does not touch a bar, except perhaps at the extremity, as the curvature would indicate; but this part is broken off. The superior surfaces of the carapacial elements are of dense bone marked with coarse and fine fossæ and intervening elevations irregularly distributed.

The size of this animal is about that of the adult of the larger Japanese salamander, *Megalobatrachus*.

#### *Measurements.*

	MM.	
Width of skull between meatus auditorius.....	75	
“ “ “ “ orbits .....	31	
“ “ “ “ orbit and meatus .....	15	
“ “ orbit, transversely.....	27	
Length of skull above posterior to orbits .....	65	
Depth of malar bone at middle of orbit.....	12	
“ “ mandible “ “ “ “ .....	14	
Length of tooth exterior to alveolus.....	3	
“ “ clavicle (chord).....	78	
Widths of clavicle {	proximal.....	22
	median.....	4
	distal.....	21
Transverse diameters humerns {	head .....	35
	shaft .....	5
Length of femur .....	67	
Anteroposterior diameter of femur {	proximally.....	23
	distally.....	20
Length of tibia.....	51	

*Measurements.*

	MM.
Long diameter of head of do.....	17
“ “ “ distal end of do.....	13
Length across ends of six ribs.....	75
“ of part of carapace preserved.....	105
Width of a posterior carapacial bar.....	10
“ “ an anterior “ “.....	8
Diameters of a vertebra { anteroposterior.....	8
{ transverse.....	16
Diameters of intercentrum { anteroposterior.....	6
{ transverse.....	12

*Otocelus mimeticus*, sp. nov.

This species is represented by a skull with lower jaw in place, which is connected by a band of matrix to a carapace, and some of the bones of one of the limbs. Greater and smaller parts of thirteen bands of the carapace are preserved.

The skull is short and wide. The superior surface is nearly flat from the posterior border to between the nostrils. The muzzle does not project beyond the mouth border. The orbits and nostrils are not superior in direction, although the superior orbital border is excavated. The nostrils are directed forwards and a little laterally; they are separated by a space equal to the transverse diameter of each. The auricular meatus is large and is directed outwards and not upwards. The posterior hooks of the quadrate project on each side beyond the slightly concave posterior border of the cranial table. Interorbital region flat, considerably wider than the diameter of the orbit.

The carapace commences at a point about as far posterior to the skull as the posterior border of the latter is behind the orbits. The anterior band has an obtuse anterior border like that of the anterior border of the carapace of an armadillo. The bands are gently convex from side to side, and they become narrower anteroposteriorly as we pass backwards. The state of the specimen is such that neither ribs nor vertebrae can be discovered.

As compared with the *O. testudineus* the following differences appear. The table of the skull projects beyond the posterior hook of the quadrate in the former; not so far in the latter. The auricular meatus and orbit present more laterally in the *O. mimeticus*, more vertically in the *O. testudineus*. The size of the two species is not very different.

*Measurements.*

	MM.
Length of skull on middle line.....	120
Width “ “ at posterior border of orbits.....	90
“ “ “ between orbits.....	38
“ “ “ “ nostrils.....	22



*Measurements.*

	MM.
Length of skull (median) to anterior border of orbits . .	78
Distance from skull to carapace . . . . .	65
Length of thirteen carapacial bands . . . . .	155
Anteroposterior diameter of first band . . . . .	17
“ “ “ seventh band . . . . .	12

The species is named to express the superficial resemblance to the *Dissorhophus articulatus*.

CONODECTES FAVOSUS, gen. et sp. nov.

*Char. gen.*—Quadrate bone extending posteriorly so that the mandibular articulation is opposite the posterior border of the cranial table. Meatus auditorius small, connected with a meatal notch. Nostrils directed upwards and a little outwards. Teeth conic, acute, increasing in length to the middle of the maxillary region.

This genus is of much interest, as it displays the character of the family in a less pronounced degree than the genus *Otocœlus*, and thus approximates more nearly the other forms of *Cotylosauria*. Its structure illustrates how the meatus auditorius has arisen by the emargination and excavation of the posterior part of the cranial roof of the *Cotylosauria*. In the other families the access of the internal ear to the external median is closed by the thin temporal roof.

*Char. specif.*—Established on a cranium with lower jaw in place, which lacks the left half posterior to the orbit, and a piece from the middle of the right side. Both nostrils and a part of the border of the left orbit are preserved, together with the teeth as far posteriorly as the orbit, the premaxillaries imperfectly. A large part of the palate is preserved. The teeth preserved show that the premaxillary teeth are small as in the *Isodectes megalops*, and that they increase in length posteriorly. The maxillopalatines are excavated on the median line so as to present two parallel ridges which continue as far as the posterior border of the internal nares. These ridges probably continue on the palatine bone and they support each a tooth near the posterior extremity. In *Isodectes megalops* the palatines support numerous small teeth on their inner borders. I find no trace of the interior rows of maxillary and mandibular teeth which are characteristic of the *Pariotichidæ*. Some such teeth may, however, have existed, as a portion of the maxillary bone is wanting from both sides of the skull.

This species is seven or eight times the linear dimensions of the *Isodectes megalops*, and a little smaller than the *Otocœlus testulineus*. The skull is as wide posteriorly as it is long, and is rather depressed, so that the orbits and nares have a vertical as well as a lateral presentation. The muzzle is flat and projects beyond the lower jaw, and it is rounded in outline, and not narrowed and portuberant as in most of the species of *Pariotichus*. The internareal and interorbital regions are flat. The



narrower brain case is continued between the orbits, and its lateral walls are robust. The palatine bones extend from the maxillaries, and approximate each other nearly on the median line, where they are separated medially by a groove, which becomes wider posteriorly. No teeth can be discerned in the specimen, excepting the large anterior one already mentioned. The surface of the bone is, however, not in good condition. The plate of the pterygoid extends to the jugal on each side, and its posterior border is but little deflected, and is at right angles to the long axis of the skull, with indications of teeth. The posterior branch of the pterygoid is slender. The occipital region is injured. The superior surface of the skull is sculptured, on the posterior frontal region in a coarse honeycomb pattern, the ridges occasionally forming small tubercles.

The teeth are conic, acute, and with a round section. In this respect they differ from those of most of the species of *Pariotichus*, where the crowns are obtuse. They are rather closely placed, and they increase in length to below the anterior border of the orbit. Their character posterior to this point cannot be ascertained. The single, large palatine tooth is similar to the maxillaries in form, and equals in dimensions the maxillary tooth which is below the posterior border of the nostril. The posterior border of the internal nostril marks a point half way between the posterior border of the anterior nostril and the anterior border of the orbit.

<i>Measurements.</i>	MM.
Total length of skull.....	158
Width posteriorly.....	152
Width between nostrils.....	20
Length from end of muzzle to posterior border of pterygoid plate.....	103
Width between summits of ridges of vomer.....	10
Length from posterior border of nostril to anterior border of orbit.....	41
Length of longest maxillary tooth.....	10
Diameter of longest maxillary tooth at base.....	3.5

A part of the muzzle of a second individual was found at the same locality.

#### DIADECTIDÆ.

I am now able to make some additions to the family of the Diadectidæ. I omitted also in my recent synopsis\* of the genera to include the genus *Phanerosaurus* Von Meyer, from the Permian of Germany, which I had previously referred to this family.† A revision of the species

\* *Proc. Amer. Philos. Soc.*, 1895, December, p. 411.

† *Transac. Amer. Philos. Soc.*, 1892, p. 13.

indicates a somewhat different generic reference to that which I have hitherto adopted, as the generic characters have only now become clear to me. The following are the generic characters as I now understand them :

I. Posterior maxillary teeth transverse, depressed, molariform, the heel (external above, internal below) broad and flat.

Skull without dermal or osseous sutures.....*Empedius* Cope.

II. Posterior maxillary teeth compressed, transverse, with non-molariform edge or apex, except on wear.

*a* Teeth with an external heel, besides the apical cusp.

Cranial bones coössified; dermal scuta few or none.....*Diadectes* Cope.

*aa* Teeth with a cusp only.

Adult cranium sutureless.....*Bolbodon* Cope.

Cranium with osseous but no dermal sutures.....*Phanerosaurus* V. M.

Cranium with both osseous and dermal sutures.....*Chilonyx* Cope.

The species of these genera are the following :

*Empedius fissus* Cope.

“ *molaris* Cope.

*Diadectes sideropelicus* Cope.

“ *phuseolinus* Cope.

“ *latibuccatus* Cope.

“ *biculminatus* Cope.

*Bolbodon tenuitectus* Cope.

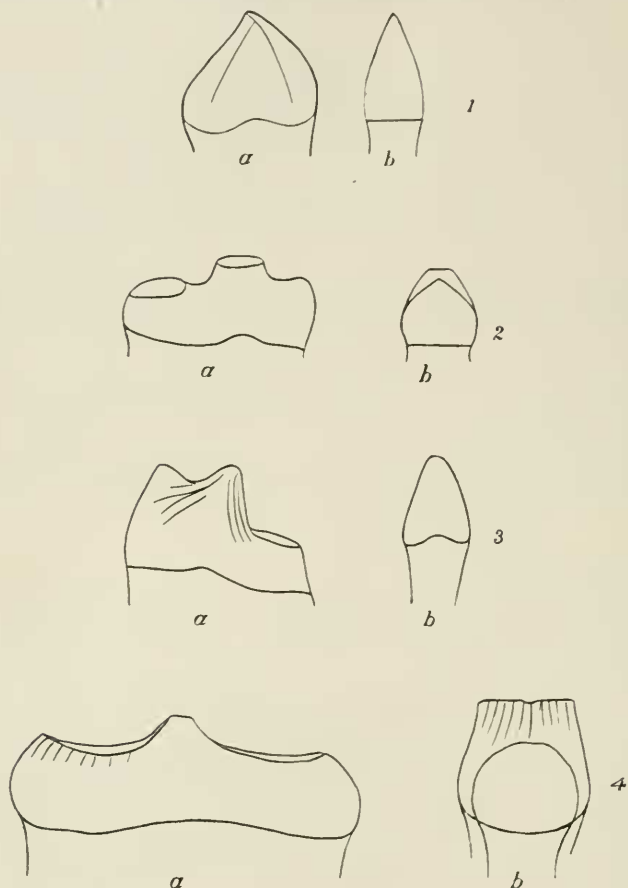
*Phanerosaurus naumannii* Von Meyer.

“ *pugnax* Gein. n. Deichm.

*Chilonyx rapidens* Cope.

The above species are from the Permian bed of Texas, excepting the two species of *Phanerosaurus*, which are from the corresponding horizon in Germany. This genus displays the hyposphen-hypantrum articulation in a less perfect degree than it appears in the American genera where it is known, but it is nevertheless present. It presents conspicuously other characters of the family in the broad closely articulating neural arches, and short, robust neural spines

The molar teeth of three of these genera are represented in the accompanying figures. Nos. 1 and 4 are superior molars, and Nos. 2 and 3 are inferior molars. Their parts are reversed in the two jaws.



1. *Bolbodon tenuitectus*. 2. *Diadectes phascolinus*. 3. *Diadectes biculminatus*. 4. *Empedius fissus*.

a. Posterior view.

b. End view.

The new forms of the family are as follows :

*DIADECTES BICULMINATUS*, sp. nov.

As this species is represented by a fragment of a mandible the characters can be drawn from the teeth only. These are remarkable for

their compressed form, and for the unequal elevation of the grinding surface. There is a median cusp much elevated above an external heel, which is at the base of the crown; and there is an internal cusp which is fused to the median cusp, and reaches a similar elevation. It is doubtful whether there are any interalveolar walls, as the teeth are closely placed.

The internal cusp is a little more elevated than the median, and its apex is separated from that of the latter by a shallow notch. The outer wall of the median cusp is vertical, while the inner wall of the inner cusp is convex both vertically and anteroposteriorly. The worn section of the two is unequally dumbbell-shaped. The external face of the median cusp exhibits a median rib, with a groove on each side, besides finer grooves, which are also present on the anterior faces of the crown near the external border. Internal to these, the median cusp sends shallow grooves obliquely inwards and downwards, which do not reach the base of the internal cusp. The transverse diameter of the crowns diminishes gradually posteriorly, so that the alveolus of the last one of the series is small and round.

The groove which separates the teeth from the external parapet of the jaw is half as wide as the width of the molars. Its edge is roughened with projections which separate fossæ and foramina of different sizes. The external surface of the jaw is roughened with innumerable wrinkles and tubercles separated by grooves, fossæ and foramina.

<i>Measurements.</i>	MM.
Length of series of nine teeth.....	46
Width of crown of largest molar.....	13
Elevation of external heel.....	5
"    "    internal cusp.....	11
Anteroposterior diameter.....	5
Width of mandibular ramus at do. ....	26

The specimen by which this species is known was found by Mr. J. C. Isaac in 1878. It is the "No. 2" of my description of *Diadectes sideropelicus* of the *Proc. Amer. Philos. Soc.*, 1878, p. 505.

*DIADECTES SIDEROPELICUS* Cope, *loc. cit.*

This species is represented by a left maxillary bone which contains three molar teeth in place and spaces for five or six others. A simple tooth at its anterior part is larger than is usual in the species of this family. I have accordingly defined the genus *Diadectes* as characterized by the presence of a canine tooth. It is, however, not possible to determine whether the other simple teeth may not have been of equal proportions, as they are represented by alveoli in the specimen. I therefore define the genus by the molar characters, which are distinct. In this respect the species *D. latibuccatus* and *D. phaseolinus* agree with it. In the last-

named the heel of the molars is larger than in the two others, approaching remotely the genus *Empedias*. The *D. latibuccatus* differs from the *D. sideropelicus* in the smaller number of molar teeth, and smaller and more numerous caniniform teeth.

*BOLBODON TENUIPECTUS*, gen. et sp. nov.

*Char. gen.*—Molar teeth without external heel, and with one median cusp. Cranial bones coössified; no grooves indicating the sutures of dermal scuta. Internal borders of palatine bones in mutual contact, and dentigerous.

The dentition of this genus is not different from that of *Phanerosaurus*, as described and figured by Geinitz and Deichmüller.\* In that genus, according to these authors, the cranial elements are distinct, the sutures being persistent. In *Bolbodon* the cranial elements are entirely coössified, excepting only the tabular bone, which is distinguishable. The nostril is large, and a turbinal bone is visible within it as in *Pariotichus*. The lateral and inferior bones of the brain case, and the mandible, are not preserved.

*Char. specif.*—This species is represented by a portion of the cranium, which includes nearly the entire right side, and a portion of the median part of the superior wall from the tabular border to the premaxillary inclusive. The vomer and the middle portions of the palatines, with the right premaxillary and maxillary bones, are preserved.

From the middle line at the apex of the vomer to the posterior extremity of the maxillary bone there are alveoli for seventeen teeth. Of these six only are occupied by teeth, which are numbers 5, 7, 10, 12, 13, 16. Of these only numbers 5, 13 and 16 have perfect crowns. The skull has been somewhat distorted by pressure, so that the longer axis of the roots and crowns are somewhat oblique to their correct positions. The roots of numbers 5 and 7 are wide-oval in section, and the long axis becomes longer posteriorly up to the number 16, in which it is a little contracted, and where the entire dimensions are smaller. The crown of number 5 is caniniform and acute, is curved backwards as to its anterior face, and has a worn posterointernal face due to the opposing tooth of the inferior series. In number 13 the crown is much more expanded transversely, and the external vertical border is convex medially and incurved above and below. Curved shallow grooves radiate from the external apex downwards and inwards. The crown of the sixteenth tooth is cordiform, with the acute apex upwards. Shallow grooves descend from the latter. Like the maxillary teeth the palatines are widely spaced. The sections of their crowns are a wide oval placed longitudinally; apices lost.

The nostril is large and is rounded subquadrate. The orbit is large and is subround, and its border is not notched as in the *Diadectes latibuccatus*, nor the superior border depressed as in *D. phascolinus*. The

\* *zit. heilungen min.-geol. u. prähist. Museum of Dresden, 1882, p. 10.*

interorbital space is gently convex, and is wider than the diameter of the eye, but how much wider the state of the specimen leaves uncertain. The jugal bone is quite narrow below the orbit, its vertical diameter equaling two-fifths that of the latter. The surface of the cranium is rather minutely wrinkled, and does not display the grooves seen in the *Diadectes latibuccatus*. The tabular bone forms a rounded and narrowed cap of the posterolateral angle of the skull, and is much less prominent than in the genus *Chilonyx*, but more so than in *Diadectes*, where it is not distinguishable by suture.

Measurements.	MM.
Total length of cranium from premaxillary border to os tabulare inclusive . . . . .	284
Diameters of nostril { vertical . . . . .	25
{ transverse . . . . .	33
Distance from nostril to orbit . . . . .	78
Diameters of orbit { vertical . . . . .	53
{ transverse . . . . .	54
Interorbital width (posterior to middle) . . . . .	70
Length of dental series (chord) . . . . .	150
Diameters m. v { longitudinal . . . . .	15
{ anteroposterior . . . . .	7
{ transverse . . . . .	10
Diameters m. xii { longitudinal . . . . .	13
{ anteroposterior . . . . .	6.5
{ transverse . . . . .	13
Diameters m. xvi { longitudinal . . . . .	10
{ anteroposterior . . . . .	5
{ transverse . . . . .	8.5

The dimensions of this skull are equal to those of the *Diadectes phaseolinus*, and about one-fourth larger than those of the *D. latibuccatus*. The bones of the cranium are thinner and lighter than those of any other species of the family that has come under my observation.

#### PARIOTICHIDÆ.

##### PARIOTICHUS ADUNCUS, sp. nov.

Represented by a cranium of which the muzzle and right side, with the right ramus of the mandible, are preserved, together with some other fragments, of one individual; and by a distorted cranium of a second.

The species is intermediate in size and characters between the type of the genus *P. brachyops* and the larger *P. aguti*, besides presenting a number of peculiarities of its own. The elongate maxillary teeth are graded in size to the smaller, and the sixteenth from behind, the largest,

is nearer the anterior border of the orbit than to the nostril. In front of it are three teeth which are preceded by an interval. There are three and perhaps four incisors on each side, of which the external two are small and the internal two very large, the inner the largest. The mandibular teeth increase regularly in length anteriorly. The nostrils are lateral and absolutely terminal. The premaxillary bones are recurved so that the alveolar edge is in vertical line with the posterior border of the nostril. Thus this recurvature exceeds that seen in any other species of the genus, and the symphysis mandibuli is correspondingly posterior. The orbits are larger than in any other species, exceeding the interorbital width considerably, and equaling the length of the muzzle from the orbit to the middle of the nostril. The muzzle is wide above in proportion to its length. It is probable that the width of the skull behind does not exceed the length from the posterior border to the front of the orbit, though this measurement is uncertain owing to the mutilated condition of the right side.

The surface is sculptured with shallow pits separated by rather thick ridges. The nasal bones send back a short angle of the external margin to meet the inferior prefrontal suture, about halfway between the orbit and nostril.

<i>Measurements.</i>	MM.
Length of skull to end of os quadratum.....	54
“ “ posterior to orbit.....	18
“ orbit.....	15
Length from orbit to nostril.....	12
Width of muzzle at middle.....	15
“ interorbital space.....	10
“ internareal “.....	8
Length of recurved part of premaxillary.....	7
“ premaxillary I, 1.....	5
“ longest maxillary tooth.....	4
Depth of mandible at middle of orbit.....	6

From the Permian formation of Texas.

#### ? PARIASAURIDÆ.

LABIDOSAURUS HAMATUS Cope, gen. nov. *Pariotichus hamatus* Cope, *Proc. Amer. Philos. Soc.*, 1895, p. 448, Pl. viii, Figs. 1 and 2.

*Char. gen.*—One series of pleurodont maxillary teeth slightly unequal in size. Internal incisor much enlarged, conic, acute, and directed backwards. No teeth on the maxillopalatines; teeth on the palatines small, subconic, in one row. Nostrils lateral.

Better specimens of the above species show that it has but one row of maxillary teeth, which are pleurodont, so that it is clearly a member of a genus distinct from *Pariotichus*. If the character I have assigned as



definitive of the Pariotichidæ be the true one, the genus *Labidosaurus* must be referred to a different one, and I know of no character at present to separate it from the *Pariasauridæ* of which the known species are so far as known up to the present time restricted to South Africa. It differs from the known genera of that family in the greatly elongate premaxillary teeth, and in the simple conic dental crowns.

*Char. specif.*.—Specimens since received display numerous characteristic peculiarities not preserved in the type. The sculpture of the cranial surfaces is in shallow fossæ with rather thick partitions, of smaller size than in the *Pariotichus aguti*, which resembles it most nearly. Thus there are a dozen ridges between the orbits on the front in the latter, while there are fifteen to seventeen in the *L. hamatus*. The maxillary teeth are relatively smaller than in any of the species of *Pariotichus* known, and they extend only to below the middle of the orbit. The orbit is subround; in the type it is oval, perhaps owing to pressure. Its diameter is about half the length of the skull, both anterior and posterior to it, and equals the interorbital width. The nostril is anteroposteriorly oval, and the apex of the elongate incisor tooth is below its anterior part. Thus, though the muzzle is more elongate than in any of the species of *Pariotichus*, it does not project so far beyond the premaxillary border. Length of skull of new specimen 155 mm.

#### APPENDIX ON A SPECIES OF TRIMERORHACHIS.

##### TRIMERORHACHIS CONANGULUS, sp. nov.

Size, the least of the species of the genus. Angle of the mandible produced, conic. Orbits rather large, the posterior border nearer the line of the end of the muzzle than to the posterior extremity of the mandibular angle, but not so near as to the posterior border of the tabular bone. External nares half way between orbit and end of muzzle. Interorbital width equal diameter of orbit.

Teeth small, the crowns elongate and acute. Twenty-two may be counted from the posterior end of the series to a point opposite the anterior border of the orbit. A much larger tooth is situated on the external border of the maxillopalatine ("vomer"), a little distance in front of the choanæ, while an equally large one is situated directly on the posterior border of the latter. Another tooth of equal size is situated external to the posterior tooth, near the maxillary border, and the base of a smaller one is visible beneath the two.

The mandibular ramus becomes quite slender anteriorly. Posteriorly, the sutures of the angular, articular, dentary and splenial, are distinct. The symphysis projects beyond and turns up in front of the premaxillary border. The angle projects considerably beyond the quadrate, and is rounded below and at the sides. The extremity is vertically grooved, but whether accidentally or normally I cannot determine.

The elements composing the cranial roof are mostly distinguishable.

The supraoccipitals have considerable extent on the superior face of the skull. The largest bones are the parietals, whose median suture is interrupted by the foramen at about the middle. The next largest bone is the tabular, which extends half the length of the parietal forwards. The supramastoid is pyriform and is rather small, and its anterior angle is wedged in between the posterior parts of the postfrontal and post-orbital. The postfrontals separate the frontals from the orbital border. The frontals are distinct, and their posterior border is about in the line of the posterior borders of the orbits. The supratemporal region is injured, and only the suture between the quadratojugal and jugal is visible.

The sculpture consists of radiating ridges from some point in each bone to its circumference. This point may be near the centre or one of the borders of the bone. The ridges may be more or less interrupted and inosculating. They are present on the lower jaw as well as the upper.

<i>Measurements.</i>	MM.
Length of skull on base including symphysis .....	40
Width of skull at quadrate articulations .....	36
Length of mandibular angle from do. ....	6
Transverse diameter of orbit. ....	5
Length from posterior border of skull to orbit. ....	18
Width between nostrils. ....	10

From the Permian bed of Texas.

#### EXPLANATION OF PLATES.

##### PLATE VII.

*Otocalus testudineus* Cope; parts of skull and skeleton with carapace, from above; two-thirds natural size.

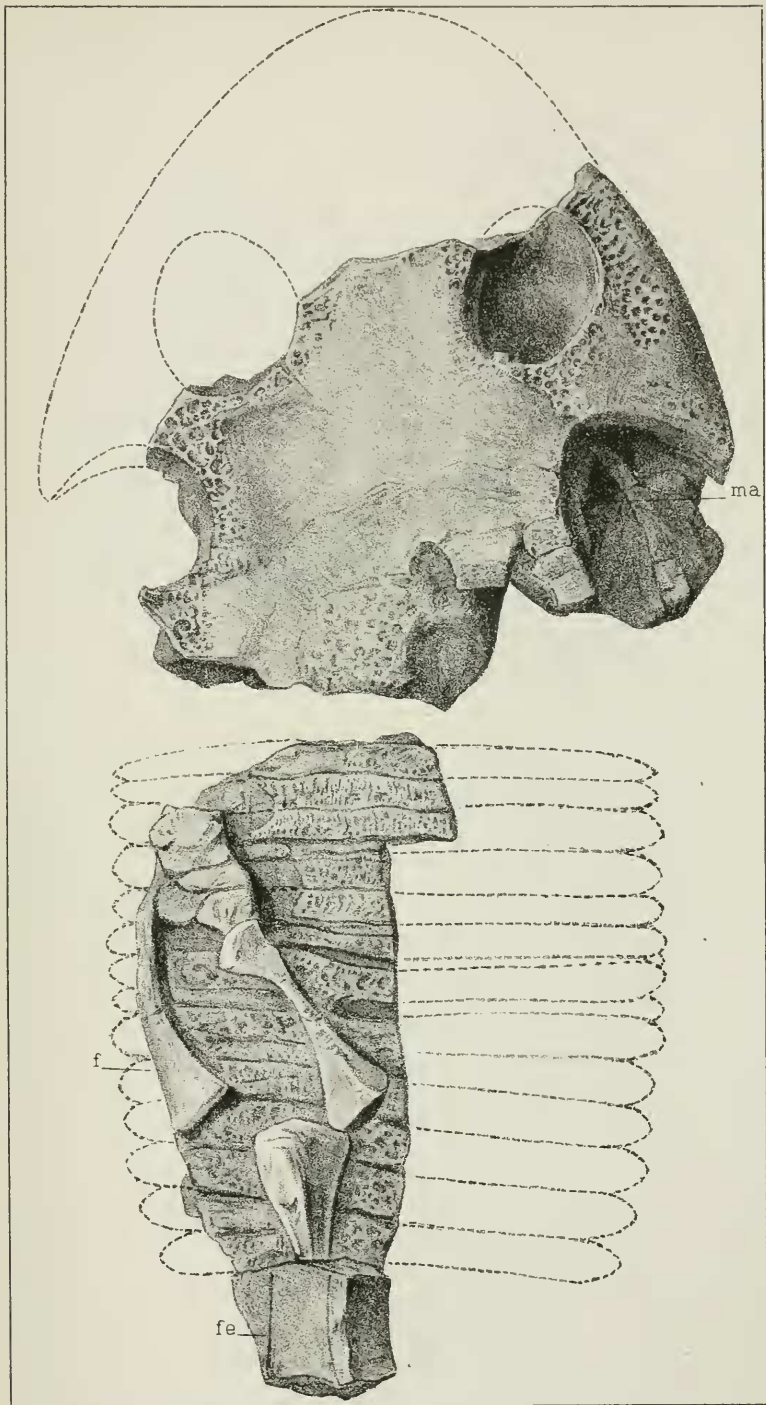
##### PLATE VIII.

*Otocalus testudineus* Cope; specimen figured on preceding plate, from below; two-thirds natural size.

##### PLATE IX.

Fig. 1. *Otocalus mimeticus* Cope; skull and part of carapace in continuous relation in the matrix, from above; three-fifths natural size.

Fig. 2. *Otocalus testudineus* Cope; broken edge of typical specimen representing sections of ribs and carapacial bands near the vertebral column; two-thirds natural size.



OTOCOELUS TESTUDINEUS COPE 2/3